WASTE DISPOSAL FOR SMALL COMMUNITIES

Alberta
ENVIRONMENT

WASTE MANAGEMENT SERIES. PUBLICATION NO. 5

WASTE DISPOSAL FOR SMALL COMMUNITIES

Prepared by

J. M. Lapp
Waste Management Branch
Pollution Control Division
Environmental Protection Services
Alberta Environment

TABLE OF CONTENTS

		PAGE
INTRODUCTION		1
CHAPTER 1	GOALS AND OBJECTIVES	2
CHAPTER 2	EVALUATING AN EXISTING DISPOSAL SITE	4
CHAPTER 3	LOOKING FOR A NEW SITE	5
CHAPTER 4	DESIGN AND CONSTRUCTION	18
CHAPTER 5	OPERATION	15
CHAPTER 6	ANNUAL COSTS	22
CHAPTER 7	PUBLIC RELATIONS	26
REFERENCES		

DRAWINGS AND PHOTOGRAPHS

FIGURE 1	EXAMPLE OF A POOR DISPOSAL SITE	3
FIGURE 2	EXAMPLE OF A GOOD DISPOSAL SITE	3
FIGURE 3	SIZE OF SITE REQUIRED	7
FIGURE 4	TYPICAL SITE PLAN	8
FIGURE 5	TRENCH FILL METHOD	10
FIGURE 6	REQUIRED TRENCH VOLUMES	11
	a) FOR LESS THAN 10,000 PEOPLE	
	b) FOR LESS THAN 1,000 PEOPLE	
FIGURE 7	AREA FILL METHOD	11
FIGURE 8	DISPOSAL TRENCH CONTROL	17
FIGURE 9	COMPACTING AND COVERING WASTE	17
FIGURE 10	ANNUAL COSTS	25

TABLES

TABLE 1	EVALUATING A PROPOSED SITE	6
TABLE 2	COMPACTION RESULTS	18
TABLE 3	FREQUENCY OF COMPACTION	19
TABLE 4	CALCULATING ANNUAL COSTS	23

INTRODUCTION

Communities with a population of less than 10,000 people have traditionally had difficulty in financing proper and safe waste disposal operations. These communities do not enjoy the economies of scale as do the large urban centres. Since equipment and personnel requirements are basically the same for both large and small disposal operations, the per capita cost is much higher for the smaller populations. It is a cost that can often be difficult to meet with increasingly restrictive budgets.

One solution to lowering the per capita cost is the development of a regional or co-operative waste disposal system with neighbouring communities. The combined population makes it possible to keep the per capita cost to a minimum for a maximum quality of service. However, in areas where regionalization may not be possible or practical, there are many simple, straight-forward concepts which can be applied to make a modified landfill acceptable to both the public and the regulators.

With increasing demands for municipal services and shrinking tax revenues, it is essential that the communities spend their money effectively and efficiently. This report has been prepared to assist small communities in efficient planning of their waste management budget, while at the same time maximizing environmental protection.

Topics which are discussed include: evaluating the existing site; looking for a new site; design, construction and operation of the site; and accounting.

CHAPTER 1 GOALS AND OBJECTIVES

Historically, waste disposal has posed numerous environmental and health problems. The uncontrolled burning of garbage pollutes the air with foul smoke, and the fire itself often poses hazards; poorly located disposal sites have a high potential for polluting water resources; uncontrolled dumps are infested with flies and other disease carrying insects; uncovered wastes offer a food source to rodents and other animals and thus there is a potential for spreading disease to other animals or to humans. Open dumps are also a source of blowing litter which results in public disfavour. Poorly controlled sites often pose safety hazards to users because of exploding cans, sharp objects and underground fires. The goal of a sound environmentally acceptable solid waste disposal facility is to protect public health and the environment from such hazards.

In order to provide safe disposal of solid waste, the following objectives must be pursued:

1. restriction of unauthorized access;
2. control of burning of wastes;
3. control of scavenging;
4. control of blowing litter;
5. maintenance of a clean and orderly site;
6. minimizing health and safety hazards; and
7. protection of water resources.

The following chapters explain how simple planning and operating techniques can help obtain these objectives.

FIG. 1 Example of a poor disposal site

FIG. 2 Example of a good disposal site

CHAPTER 2 EVALUATING AN EXISTING DISPOSAL SITE

The first step in planning waste disposal for a community is to review the existing disposal site. In order to decide whether the site can continue to be used, or whether it should be closed, the following problems that may occur at the site must be considered:

1. presence of birds, flies, rodents and other pests;
2. unauthorized burning;
3. litter, both on the site and off the site;
4. pollution of groundwater or surface water;
5. odours;
6. indiscriminate dumping;
7. no site control;
8. overfilling of a site;
9. public complaints.

A waste disposal site should be closed when any or all of the following statements apply:

1. It is no longer legal to continue its operations.
2. The site is socially unacceptable.
3. Environmental problems occur.
4. The site is filled to capacity.

The decision to close a dump can be made by asking these four questions:

1. Can it be changed to conform to the law?
2. Can it be made into a good neighbour?
3. Is it really full?
4. Is another site available?

If it is decided that the present site can be used after improvements are made, then capital and operational developments are the important aspects. If it is decided the site can no longer be used or must be closed within a few years, a new site must be located as soon as possible.

CHAPTER 3 LOOKING FOR A NEW SITE

A new disposal site must be properly located to protect the environment and the public, otherwise, the many problems that exist at the present site will continue.

Site selection criteria for disposal sites (Table 1) are concerned with meeting the following objectives:

1. environmental protection;
2. protection of the public; and
3. avoiding areas that would require special operating procedures (i.e., factors which may increase costs).

When looking for a new disposal site, the following items must be considered (summarized in Table 1):

1. Soils - Ideal soils include fine textured soils such as clays, silts, or tills, whereas sand and gravel areas are to be avoided. Rocky areas are unusable.
2. Soil Thickness - The ideal thickness of the soil layer is 35 ft. (10 m) or more. A lesser thickness may be suitable, but special design features will likely be required.
3. Groundwater - The ideal condition is that the water table is at least 5 ft. (1.5 m) below the proposed trench bottom. Lesser depths may be acceptable, depending upon the nature of the soil and the groundwater flow, although such cases may require special design considerations.
4. Surface Water - Ideal land is flat and well drained. Avoid areas such as ravines, streams and flood plains where water flows, and water bodies such as lakes or sloughs.
5. Surroundings - Considerations regarding the location of the site are defined by the Public Health Act - Waste Management Regulations. The minimum distance from a hospital, residence, or a food outlet is 1500 ft. (450 m). Minimum distance from a cemetery is 300 ft. (90 m). Minimum distance from a traffic route is 300 ft. (90 m).

TABLE 1 EVALUATING A PROPOSED SITE

ITEM	FAVOURABLE	UNFAVOURABLE	QUESTIONABLE
Soil Type	Clay, silt, tills more than 35 ft. (10 m) thick	Gravels, sand, rock	Fissured till less than 35 ft. (10 m) thick
Groundwater	No shallow groundwater	Shallow groundwater less than 15 ft. (3 m) below ground level	Groundwater present but at least 15 ft. below ground level
Surface Water	Dry flat land, well drained	Lakes, streams, flood plains	Ravines, slough areas
Social - Residence - Hospital - Food outlet - Cemetery - Roadway	 Over 1500 ft. (450 m) Over 1500 ft. (450 m) Over 1500 ft. (450 m) Over 300 ft. (90 m) Over 300 ft. (90 m)	 Less than 1500 ft. (450 m) Less than 1500 ft. (450 m) Less than 1500 ft. (450 m) Less than 300 ft. (90 m) Less than 300 ft. (90 m)	
Size	20 years usage or greater	Less than 10 years usage	10 to 20 year usage

Alberta
ENVIRONMENT
Pollution Control Division
Waste Management Branch

6. Size - The size of the disposal site, which depends upon the volume of waste it should contain, can be determined by using the population it services and using estimated generation rates for each person (Figure 3).

The local Health Unit is to be contacted for initial approval of a site. The health inspector reviews a site by considering the criteria listed above, and if the site appears to be favourable, the Health Unit requests Alberta Environment to conduct a technical evaluation. Final approval is given by the Health Unit.

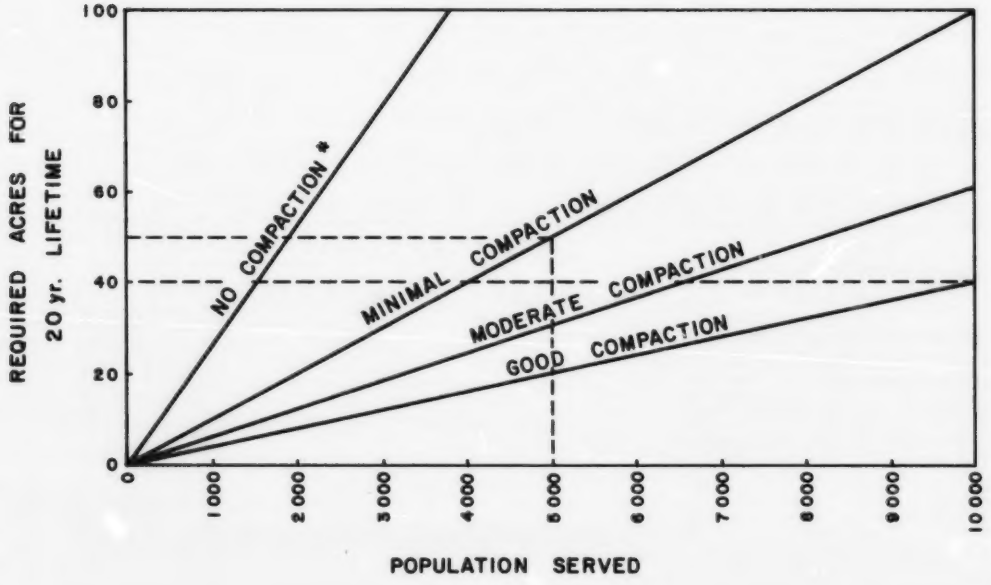


Fig. 3 SIZE OF SITE

(* See Table 2 , Page 19 for definition)

CHAPTER 4 DESIGN AND CONSTRUCTION

It is extremely important that the disposal site is designed properly, preferably by an engineer. The design should consider the aspects of the selected property, including soil conditions, site topography, drainage and other specific site conditions, and include the following information:

1. existing area
2. site plan
3. operation method
4. fencing requirements
5. excavation depths, size, location
6. roads
7. storage compounds
8. operation details

A typical site plan is shown in Figure 4.

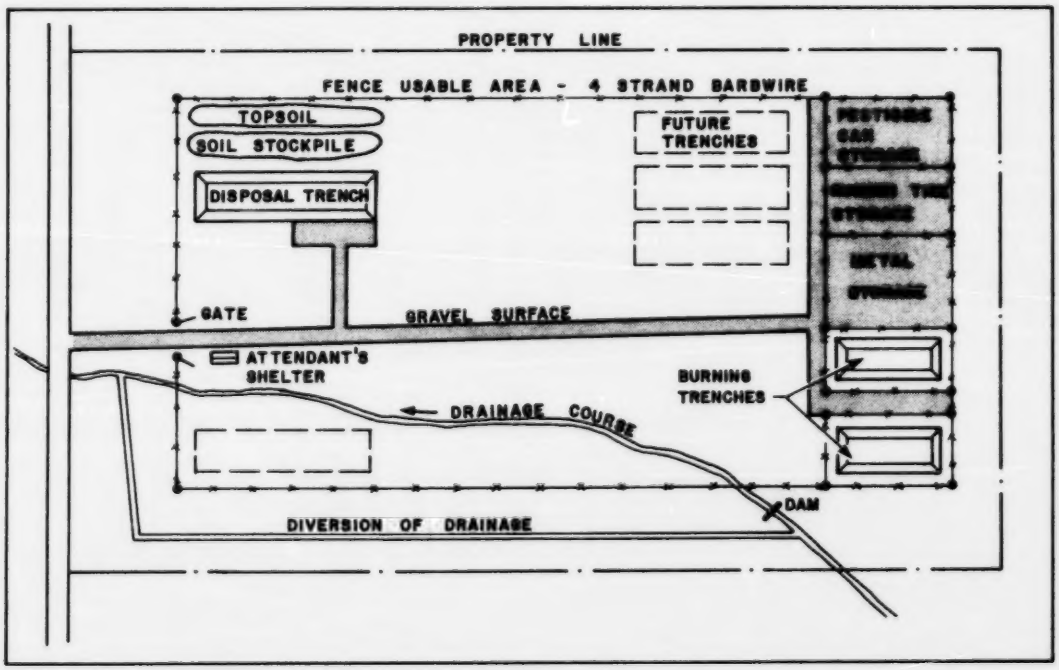


Fig. 4 TYPICAL SITE PLAN

Operation Methods

The designer of the landfill must plan the type of operation to be carried out. The two basic plans most commonly used are the trench fill and the area fill. The method used depends on the topography of the land.

Trench Method

The trench method (Figure 5) is a cut and fill operation with a trench excavated to a specific depth (usually 10 ft.). The waste materials are deposited in the trench and are compacted with heavy equipment and periodically covered with a layer of soil.

The trench method is used in flat or gently rolling terrain and where groundwater will not interfere with excavations.

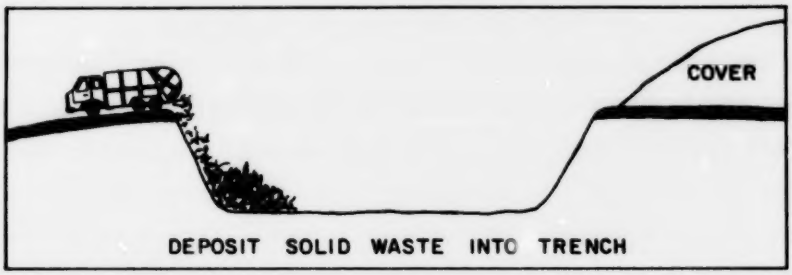
Trench preparation is done as follows:

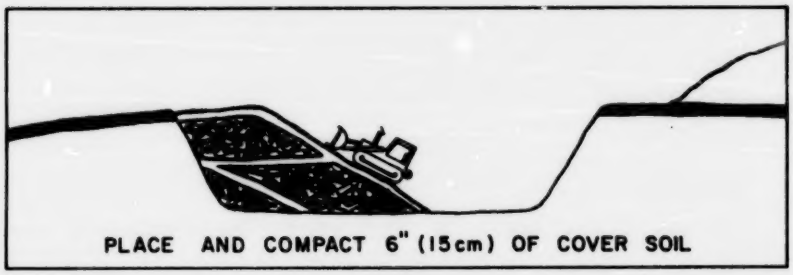
- strip topsoil and stockpile for future landscaping of the site
- excavate trench to last one year (Figure 6a and 6b)
- keep width as narrow as possible but allow enough room for heavy equipment to work when compacting and covering (minimum width 15 ft. [4.5 m])
- berm the edge of the trench to shed precipitation water.
- stockpile excavated soil to ends or one side of the trench
- excavate with cat and scrapers, bulldozers or loaders are suitable for excavation.

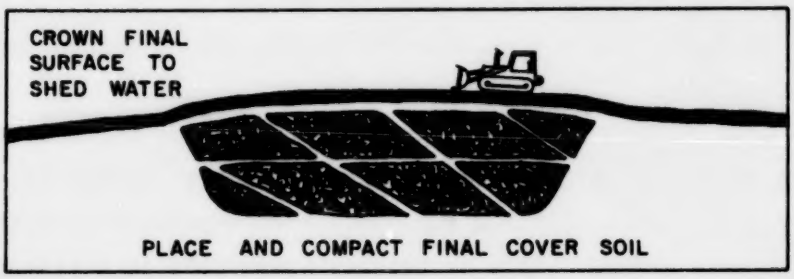
Area Method

In the area fill method (Figure 7), wastes are deposited directly on the ground surface and the wastes are compacted and covered regularly.

The area fill is used where natural or man-made depressions exist, or where trenching is impractical. The area method is generally a more difficult and sometimes more expensive operation than the trench method. This is because cover soil is difficult and expensive to obtain







Alberta
ENVIRONMENT
Pollution Control Division
Waste Management Branch

Fig. 5 TRENCH METHOD

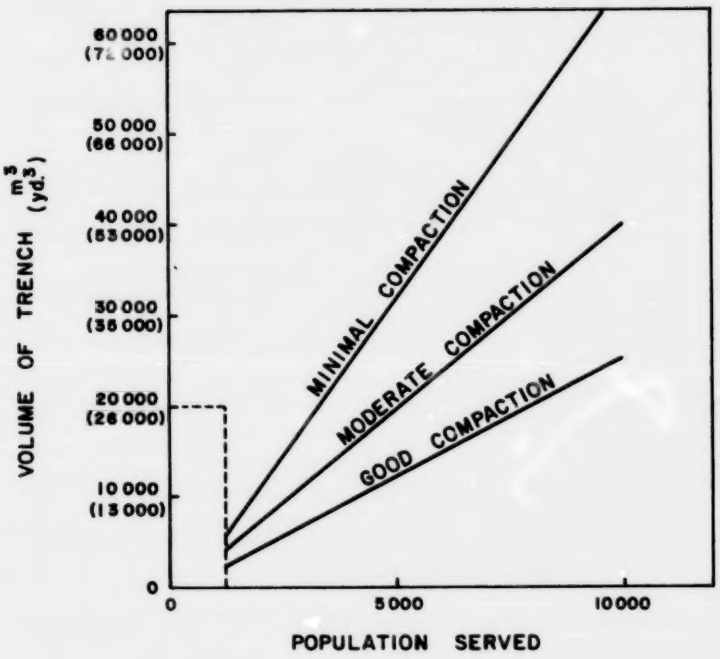


Fig. 6a FOR LESS THAN 10000 PEOPLE

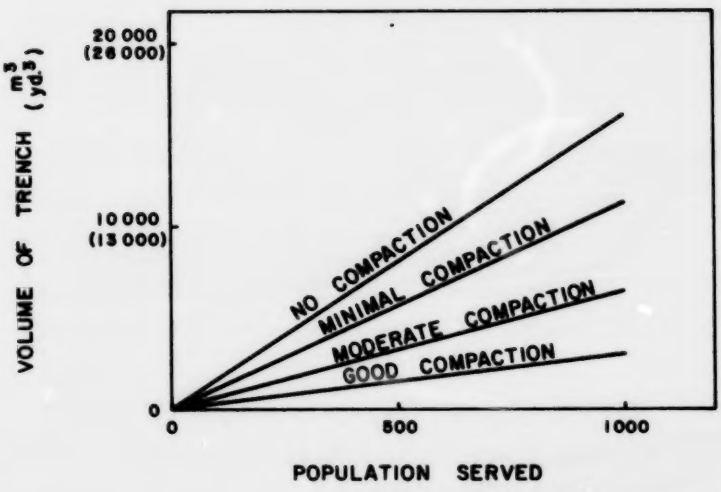
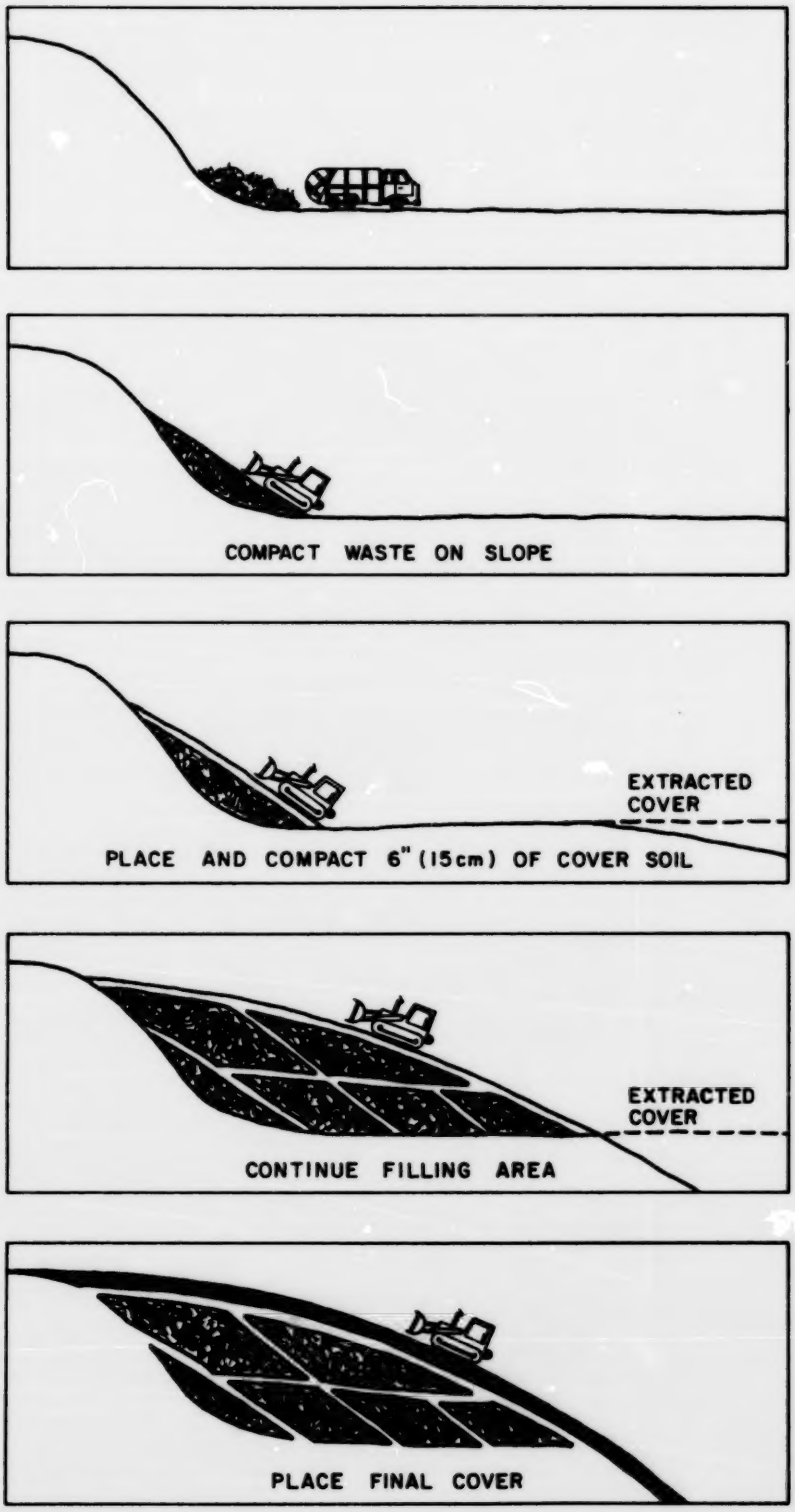


Fig. 6b FOR LESS THAN 1000 PEOPLE

Fig. 6 REQUIRED TRENCH VOLUMES

Alberta
ENVIRONMENT
Pollution Control Division
Waste Management Branch



Alberta
ENVIRONMENT
Pollution Control Division
Waste Management Branch

Fig. 7 THE AREA METHOD

Preparation for area fill is done as follows:

- strip and stockpile topsoil for final landscaping
- import cover material if no cover is available on the site.
- fence or berm the dumping area to control the size of the operation.

Site Components

The waste disposal facility should be designed to have the following components included in the construction.

1. Fencing - Perimeter fencing to restrict access of humans and large animals. The perimeter fence is also a litter control device. A chain-link fence is suggested.
2. Gates - Entrance gates to restrict unauthorized access after hours.
3. Signs - Direction and information should be placed at the entrance and at specific areas of the disposal site.
4. Litter Control - Catch-fences may be constructed in the dumping area.
   - Windbreaks such as treelines or snow-fencing can be developed.
5. Roads - Roads should be well drained and properly surfaced to allow all-weather access.
6. Buildings - An attendant's shelter may be required; an equipment shelter may be required on larger sites.
7. Equipment
   - Ideal equipment includes tracked loaders or bulldozers. Rubber tired loaders may be suitable if tire protection can be provided.

- Equipment may be supplied by the community equipment pool contracted or purchased specifically for the site.

8. Storage Compounds

- Tires and metals may be stored in fenced or bermed areas.
- Pesticide containers can be stored in fenced compounds.

9. Burning Area

- If permitted by the Health Unit, a separate burning area may be constructed. Burning trenchs require a fire guard.
- Two burning pits should be constructed. Each pit should be separately fenced with a gate that can be locked.

CHAPTER 5 OPERATION

The right location, design and construction of a disposal site are not enough to make waste disposal successful. It is the operation of the site that is seen by the public and the regulatory bodies, and therefore is the measure of the disposal site's effectiveness.

An operational plan should be developed during the design stage, while considering following areas of the operation;

1. Unloading Wastes

- Wastes must be deposited in the proper location.
- Non-recyclable wastes must be dumped directly into the trench or dumping area.
- Log stops will help mark the edge of the dump area.
- Fencing can be used to control the size of the dumping area.

2. Waste Separation

- Clear, concise signs are required to define storage, disposal and burning areas, and the wastes to be deposited in each area.
- Supervision may be required if problems occur.

3. Burning

- Only wastes defined as "burnable debris" in the Clean Air (General) Regulations are allowed (i.e. straw, grass, leaves, tree prunnings, brush, power poles, wooden construction or demolition materials.

- wastes defined as "prohibited debris" in the Clean Air (General) Regulations cannot be burned (i.e. animal cadavers, animal manure, pathological wastes, non-wooden

construction and demolition wastes, railway ties, automobile bodies, rubber and plastic products, used engine oil, used transformer oil, and residential, commercial, and industrial garbage).
rubber and plastic products, used engine oil, used transformer oil, and residential, commercial and industrial garbage).

- Burning of paper must be avoided, since it poses a fire danger with airborne burning paper.
- Objectionable material may have to be removed prior to burning. The area should be checked frequently.
- If two burning pits are used, burning can take place in one, while incoming debris is deposited in the other. Burning in the second pit is allowed only when the active fire in the first is extinguised.
- Burning permits must be obtained from the health unit.
- Burning operation should be supervised.

4. Storage of Recyclables

- Storage areas must be maintained in a clean and orderly manner.
- Clean-up should be regular (as required).
- Recyclables should be picked up for recycling when storage areas fill or become unsightly.
- Pesticide cans may be stored in a separate approved compound.

5. Compacting Wastes

- Required to increase the life of the site and to minimize the cost of reclamation.
- Tracked equipment should be used if available..
- Wastes are spread in layers and each layer is compacted with up to five passes of the equipment (Figure 9).

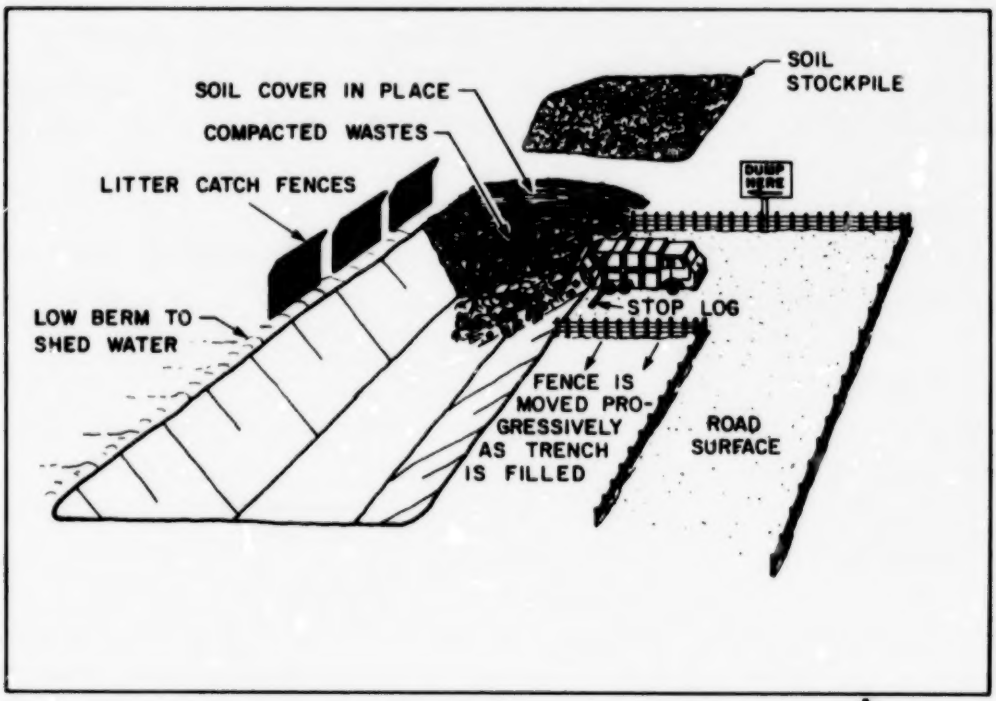


Fig. 8 DISPOSAL TRENCH CONTROL

Alberta
ENVIRONMENT
Pollution Control Division
Waste Management Branch

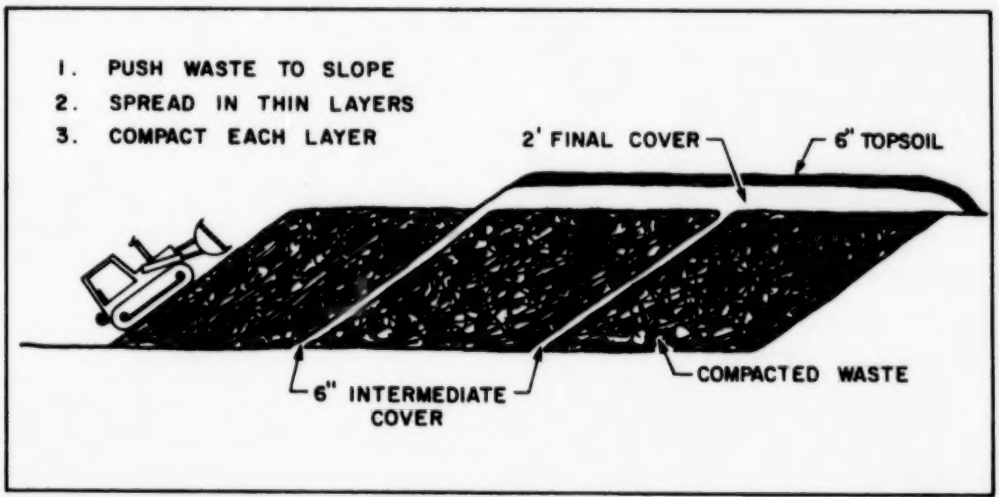


Fig. 9 COMPACTING AND COVERING WASTES

Alberta
ENVIRONMENT
Pollution Control Division
Waste Management Branch

TABLE 2 COMPACTION EFFORT

COMPACTION	EQUIPMENT	METHOD	DENSITY
Poor	None	Wastes dumped into trench	100 - 200 $\frac{lb}{yd^3}$ 60 - 120 $\frac{kgm}{m^3}$
Minimal	Tracked Machine	Waste dumped into trench. Equipment compacts surface of wastes.	200 - 500 $\frac{lb}{yd^3}$ 120 - 300 $\frac{kgm}{m^3}$
Moderate	Tracked Machine	Wastes spread in layers. Each layer is compacted with one pass of the machine.	500 - 800 $\frac{lb}{yd^3}$ 300 - 475 $\frac{kgm}{m^3}$
Good	Tracked Machine	Wastes spread in thin layers. Each layer compacted with three to five passes of the machine.	800 - 1000 $\frac{lb}{yd^3}$ 475 - 600 $\frac{kgm}{m^3}$
Excellent	Steel Wheeled Compactor	Wastes spread in thin layers. Each layer compacted with the machine with up to five passes.	over 1000 $\frac{lb}{yd^3}$

- Compaction effort is shown in Table 2.
- Frequency of compaction is shown in Table 3.

TABLE 3 FREQUENCY OF COMPACTION

POPULATION SERVED	DAILY WASTE* VOLUMES LBS (KGM)	FREQUENCY OF** COMPACTION
1,000 OR LESS	5,500 (2,500)	1 x per month
2,000	11,000 (2,500)	2 x per month
3,000	16,500 (7,500)	3 x per week
4,000	22,000 (10,000)	1 x per week
5,000	27,500 (12,500)	2 x per week
10,000	55,000 (25,000)	1 x per day

* Based on a generation of 5.5 lb per person per day (2.5 kgm)
** Based on a minimum of 2 hours equipment time for each time wastes are compacted.

6. Covering Wastes

- Covering material is excavated from the soil stockpile.
- Wastes are to be covered as required by the public health regulations.
- The required thickness of cell cover is 6 inches (15 mm) of compacted soil.
- Since the equipment time to cover is minimal, it would be worthwhile to cover the waste at the same frequency as compaction.

7. Litter Control

- Windblown debris must be picked up regularly.
- Litter blown onto neighbouring property should be picked up as soon as possible.
- Litter along roadways leading to the site must be cleaned up regularly.
- Fences must be kept free of paper and debris.
- Portable catch-fences may be placed near the disposal area.
- Dumping area must be controlled to prevent indiscriminate dumping.
- Wastes should be covered while in transport on a vehicle.

8. Site Maintenance

- Wastes must be pushed into the disposal trench frequently. The frequency will depend upon the volume of wastes handled.
- Roads are to be kept smooth and free of debris and snow.
- Drainage systems must be kept free of debris and maintained to permit the free flow of water away from the disposal area.
- Fences, buildings and signs must be kept clean and in good repair.
- The overall site must be kept clean and orderly.

9. Hours of Operation

- The site should be closed at night to prevent indiscriminate dumping.
- If the site is supervised, the hours of operation may be limited by the operating budget.
- The hours of operation must be posted at the entrance.

10. Supervision

- A supervisor may or may not be required to maintain control of the waste disposal site depending on one or all of the following requirements.
  (a) waste volume warrants it;
  (b) continuous operation difficulties occur;
  (c) users do not follow rules;
  (d) burning of wastes occurs;
  (e) training the public at a site is required (temporary supervision); and
  (f) where required by the health unit.

The supervisor's duties include:

(a) site maintenance;
(b) ensuring that wastes are deposited in the proper location;
(c) control of the type of wastes deposited;
(d) supervision of burning, if burning is approved;
(e) ensuring that no unauthorized burning occurs; and
(f) prevention of unauthorized scavenging.

11. Trench Completion

- A final cover of at least two feet (0.6 m) of compacted clay soil is placed over a filled trench or area.
- The final cover is shaped to shed water.
- The area is covered with topsoil and seeded to grass.

CHAPTER 6 ANNUAL COSTS

It is important that the costs to operate a waste disposal facility are properly recorded. Costs records provide information to the administration when preparing budgets for the following year of operation.

Historically, costs of waste disposal have been poorly recorded, and, in some cases, communities considered the cost to be nil because they lacked records. Recording the actual costs of disposal provides the community with good information that can be used for long-term planning of waste disposal operations and alternatives.

The costs for disposal do not include only the cost of labour, equipment and site maintenance, but also the costs for site development reserve and reclamation.

To determine the annual cost of operating a waste disposal facility, the following method (Table 4) can be used. This method may also be used to estimate the cost of operating a new disposal site or upgrading an existing site.

TABLE 4 CALCULATING ANNUAL COSTS

1. LABOR
   (a) Rate $_____ per hour
   (b) Supervision _____ hours per year
   (c) Clean-up _____ hours per year
   (d) Total time _____ hours per year
   (e) ANNUAL COST $_____per year

2. EQUIPMENT
   (a) Rate $_____ per hour (including operator)
   (b) Compaction _____ hours per year.
   (c) Covering _____ hours per year.
   (d) Clean-up _____ hours per year.
   (e) Site Maintenance _____ hours per year.
   (f) Total Time _____ hours per year.
   (g) ANNUAL COST $_____per year

3. TRENCH EXCAVATION
   (a) Cost per cubic yard (or m^3) $_____
   (b) Trench volume _____ $yard^3$ (or m^3)
   (c) COST $_____per year

4. UTILITIES (if available)
   (a) Power $_____ per year.
   (b) Heat $_____ per year.
   (c) Telephone $_____ per year
   (d) COST $_____per year

5. OPERATING COST (Total of 1-4)
   $_____per year

6. ADMINISTRATION (Optional 5% of Operating Costs) $$_____per year

7. CAPITAL RESERVE

(a) Initial cost $_____

(b) Expecting site life _____years

(c) ANNUAL CAPITAL COSTS $_____per year

8. TOTAL COST $_____per year

The small community does not pay as high a total cost for disposal as a large community. Figure 10 shows that the total annual cost for disposal for 500 people would be $6,000 - $11,000 per year. For a population of 10,000 people the cost may be $60,000 - $80,000 per year.

Even though the total cost is greater for larger populations, there are more people to share the costs resulting in a lower per capita cost. Figure 10 shows a cost range of $12-$22 per capita for a population of 500, while the cost for 10,000 people ranges from $6 to $8 per capita.

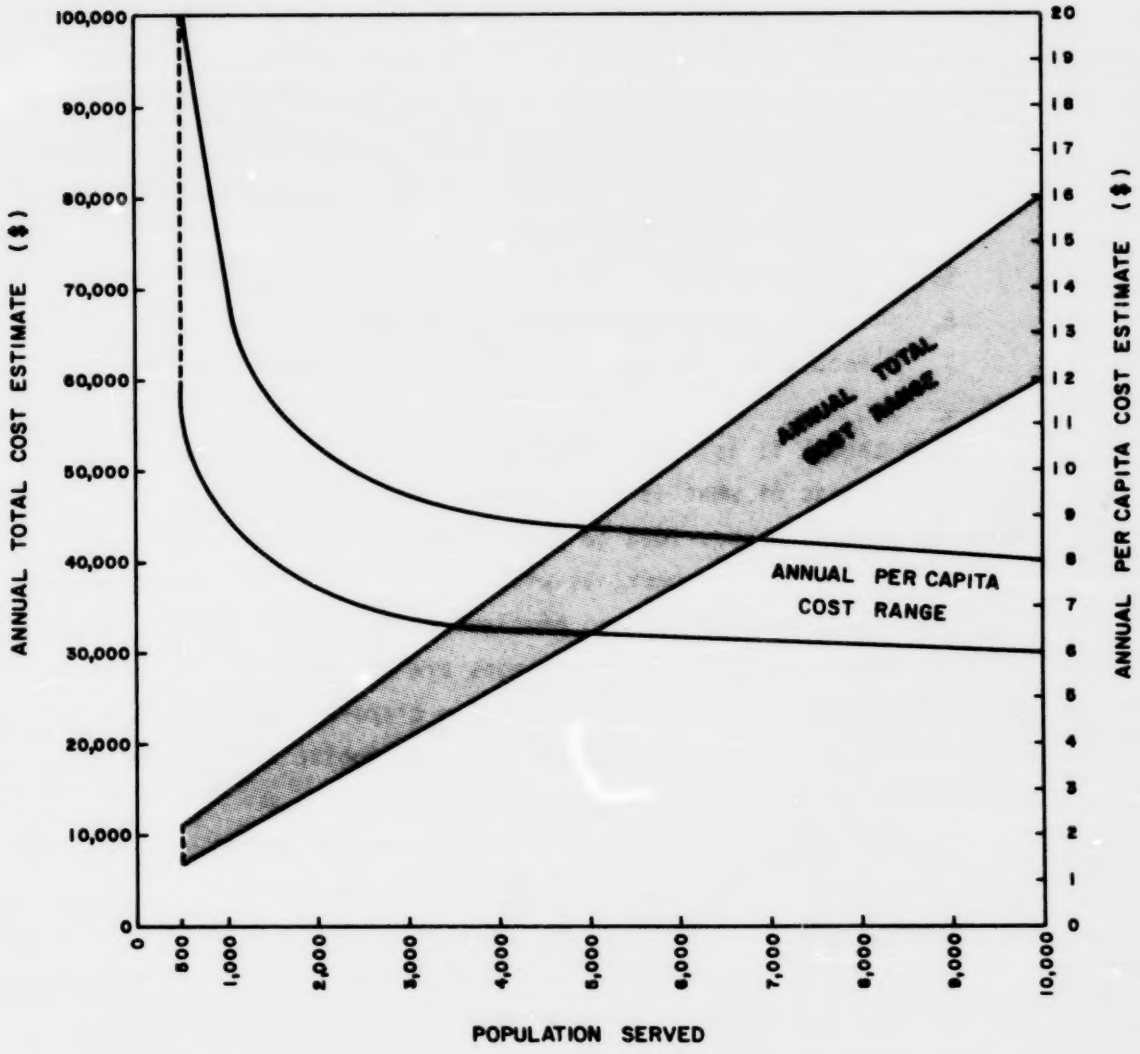


Fig. 10 ANNUAL COSTS

Alberta
ENVIRONMENT
Pollution Control Division
Waste Management Branch

CHAPTER 7 PUBLIC RELATIONS

In order to operate a waste disposal site properly, the operating community or "Authority" needs the support of an informed public. Opposition can come from different groups who push in different directions:

1. People who do not want a disposal site near them.
2. People who do not wish to spend more money.
3. People who do not believe a solution is available.
4. People who resist change.
5. People who want change.
6. People who are politically involved.
7. People who are poorly or wrongly informed.

Even though it is likely that objections and criticisms will occur regardless of what is done, correct and comprehensive information must be provided to gain support and co-operation. If any information is held back, it will result in further objections.

The existing situation and problems must be made clear so that the purpose of improvements and changes are understood. The plans for the construction and operation of the disposal site should be presented as well as information on what the public is required to do to make the system work.

The information may be distributed by various means:

1. Speakers Bureau - Speakers making presentations to service clubs, civic groups, business organizations or other groups.
2. Media - Use of radio, television and newspapers for news releases and advertising.
3. Displays - Using posters and displays in shopping centres or stores or at other centres where the public gathers frequently.
4. Brochures - Mail-out or handout brochures can be used to inform individual households or businesses.

5. Direct Contact - Passing along information by face-to-face contact with the public and community leaders.

Whether an existing disposal site is upgraded or a new site is developed, public trust, support and co-operation are achieved only by operating the site properly and setting an example.

REFERENCES

Public Health Act - Waste Management Regulations (1985)

Clean Air Act - Clean Air (General) Regulations (1984)

Alberta Social Services and Community Health -"Modified Landfills"

United States Environmental Protection Agency - "An Accounting System for Solid Waste Management in Small Communities" (1971)

Manitoba Department of Mines, Resources, and Environmental Management - "Rural Area Solid Waste Disposal" (1975)

Environment Canada - "Open Dumps: Closure and Conversion" (1975)